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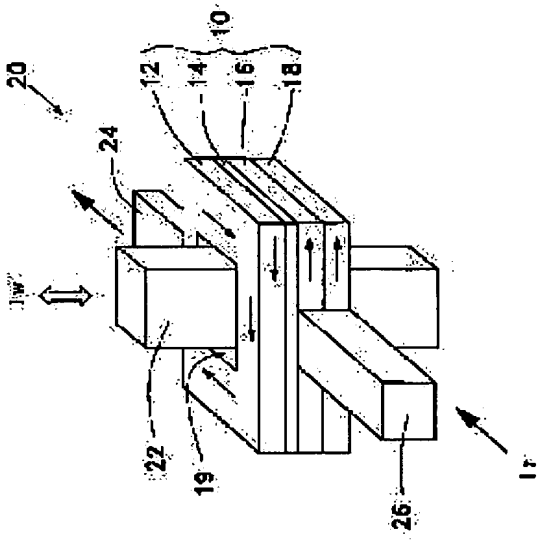
(54) STORAGE CELL, MEMORY CELL AND STORAGE CIRCUIT BLOCK

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a storage cell having a small current for writing and a small change of a switching magnetic field, and to provide a memory cell and a storage circuit block.
SOLUTION: The storage cell 10 comprises a plurality of superposed layers, a free ferromagnetic layer 12 in which the direction of a magnetization is changed by the direction of a magnetic field in a plurality of the layers, and a hollow part 19 formed, so as to pass the central part of the plurality of the layers through the plurality of the layers. The memory cell 20 comprises a conductor 22, in which a writing current flows to the hollow part 19 of the cell 10.



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* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] The storage element which contains the centrum formed so that these two or more layers might be penetrated in a part for the core of two or more layers which were put together in the pile, the layer of the ferromagnetic from which it is contained in said two or more layers, and the direction of magnetization changes with the directions of a field, and two or more of said layers.
[Claim 2] The storage element according to claim 1 with which said two or more layers contain the layer of the ferromagnetic with which the direction of magnetization established on the layer of the insulator which passes the tunnel current established on the layer of the ferromagnetic from which the direction of magnetization changes, and the layer of the insulator which passes said tunnel current was fixed by the direction of said field.
[Claim 3] The storage element according to claim 2 with which the layer of the antiferromagnetic substance for fixing the direction of magnetization of the layer of this ferromagnetic was prepared on the layer of the ferromagnetic with which the direction of said magnetization was fixed.
[Claim 4] The memory cell containing the storage element containing the layer of the antiferromagnetic substance for fixing the direction of magnetization of the layer of the ferromagnetic from which the direction of magnetization changes with the directions of a field, the layer of the insulator which passes tunnel current, the layer of the ferromagnetic with which the direction of magnetization was fixed, and the layer of the ferromagnetic with which the direction of said magnetization was fixed, and the centrum formed in a part for the core of two or more layers contained in said storage element.
[Claim 5] The memory cell according to claim 4 which the conductor which passes a write-in current to said centrum has passed.
[Claim 6] The memory cell according to claim 5 whose conductor of said two or more layers which passes said write-in current is non-contact.
[Claim 7] The memory cell according to claim 4 or 6 which connected to the layer of the ends of two or more of said layers the conductor which passes a read-out current.
[Claim 8] the store circuit block containing the memory cell according to claim 7 by which the conductor which passes a write-in current, the conductor which carries out reading appearance and passes a current, and the conductor which carries out reading appearance to the conductor which passes said write-in current, and passes a current have been arranged in the shape of a matrix, and has been arranged at the intersection.
[Claim 9] Two or more layers which were put together in the pile, and the layer of the ferromagnetic from which it is contained in these two or more layers, and the direction of magnetization changes with the directions of a field, it is ****** -- the ferromagnetic from which it is a storage element and the direction of said magnetization changes with the 1st layer A storage element including the 1st pillar-shaped object which connects one sides which the 2nd parallel layer, and this 1st layer and this 2nd layer counter by this 1st layer and non-contact, and the 2nd pillar-shaped object which connects the other sides which counter with one side of this 1st layer and the 2nd layer.
[Claim 10] The storage element according to claim 9 in which the annular solid is formed with said 1st layer, said 2nd layer, said 1st pillar-shaped object, and said 2nd pillar-shaped object.
[Claim 11] The 1st insulating layer which passes the tunnel current by which said two or more layers were further prepared on the 1st [of the ferromagnetic from which the direction of said magnetization changes] layer, The storage element containing the layer of the 1st antiferromagnetic substance for fixing the direction of magnetization of the layer of this 1st ferromagnetic established on the layer of the 1st ferromagnetic with which

the direction of magnetization established on said 1st insulating layer was fixed, and the layer of said 1st ferromagnetic according to claim 9 or 10.
[Claim 12] The 2nd insulating layer which passes the tunnel current by which said two or more layers were further prepared on the 2nd [of the ferromagnetic from which the direction of said magnetization changes] layer, The storage element containing the layer of the 2nd antiferromagnetic substance for fixing the direction of magnetization of the layer of this 2nd ferromagnetic established on the layer of the 2nd ferromagnetic with which the direction of magnetization established on said 2nd insulating layer was fixed, and the layer of said 2nd ferromagnetic according to claim 9 to 11.
[Claim 13] The storage element according to claim 12 with which the layer of said 2nd ferromagnetic contains the layer which has the direction of magnetization of the layer of the 2nd antiferromagnetic substance, and the direction of reverse magnetization by the layer which has the direction of magnetization of the layer of the 2nd antiferromagnetic substance, and the direction of the same magnetization, the layer for reversing the direction of this magnetization, and the layer for reversing the direction of magnetization.
[Claim 14] The memory cell containing the conductor which passes two write-in currents which pass the centrum of the annular solid formed with said 1st layer which constitutes the layer of a storage element according to claim 12 or 13 and the ferromagnetic from which the direction of said magnetization changes, the 2nd layer, the 1st pillar-shaped object, and the 2nd pillar-shaped object.
[Claim 15] the conductor which passes said two write-in currents -- the memory cell according to claim 14 whose comrades are non-contact.
[Claim 16] The memory cell according to claim 14 or 15 which connected the conductor which reads to the layer of said 1st antiferromagnetic substance, and the layer of said 2nd antiferromagnetic substance, and passes a current.
[Claim 17] Said 1st layer which constitutes the layer of a storage element according to claim 12 or 13 and the ferromagnetic from which the direction of said magnetization changes, The conductor which passes two write-in currents which pass the centrum of the annular solid formed with the 2nd layer, the 1st pillar-shaped object, and the 2nd pillar-shaped object by non-contact, with the conductor which was connected to the layer of said 1st antiferromagnetic substance, and the layer of said 2nd antiferromagnetic substance and which carries out reading appearance and passes a current The store circuit block were the store circuit block which has a ****** memory cell, and whose conductor which passes said two write-in currents has arranged in the shape of a matrix, and has arranged said memory cell to the intersection.
[Claim 18] The store circuit block according to claim 17 which prepared the switching element for writing in the edge of the conductor which passes said two write-in currents, and performing ON and OFF of a current.
[Claim 19] The store circuit block according to claim 18 said whose switching element is MOSFET.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to a reliable storage element, a memory cell, and a store circuit block in small power actuation.
[0002]
[Description of the Prior Art] The structure of the memory cell 80 of the 1T(transistor)1MTJ (Magnetic Tunnel Junction) type currently used conventionally is shown in drawing 4 (a). Moreover, the plan of a memory cell 80 is shown in drawing 4 (b). The MTJ component 88 is used as a storage element. The MTJ component 88 contains the free ferromagnetism layer 82 which is a layer of the ferromagnetic from which the direction of magnetization changes with fields at least, the tunnel barrier 84 which passes tunnel current, and the fixed magnetic layer 86 which is a layer of the ferromagnetic with which the direction of magnetization was fixed. The MTJ component 88 is arranged between the metal layer M2 and the metal layer M3.
[0003] The current of the writing for writing data in a memory cell 80 is applied to the vector sum of two fields which a connoisseur flows the metal layer M2 (write-in Ward Rhine 92) and the metal layer M3 (bit line 90), respectively, and are generated according to these write-in currents switching the direction of magnetization of the free ferromagnetism layer 82 of the MTJ component 88.
[0004] Since the write-in current is flowing to parallel in the MTJ component 88 and is separated from the MTJ component 88, a part of generated field is used for the change of the direction of magnetization of the free ferromagnetism layer 82. However, since all fields cannot use it for the change of the direction of magnetization of the free ferromagnetism layer 82, in the conventional memory cell 88, a write-in big current is needed.
[0005] Furthermore, a memory cell 88 has the problem that fluctuation of a SUITCHINGU field is large. A switching field is mainly defined with the configuration of the MTJ component 88 which is a pattern usually near a rectangle or a rectangle. A rectangular magnetic pattern generates the anti-field in a pattern (demagnetizing field) intrinsically, and the reinforcement of a switching field changes according to the form of the corner of a pattern. It is dramatically difficult to draw the pattern of the rectangle which includes the form of a corner in 1 micron or less. Consequently, the switching field of a pattern is changed sharply and failure of the writing of the data of a memory cell 88 occurs.
[0006] Moreover, the problem of dependability arises by fluctuation of a switching field. That is, when the switching field of a certain memory cell 88 is smaller than an external disturbance field (disturbing field), the writing of the data of a memory cell 88 occurs by this external disturbance field. As such an external disturbance field, there is a leakage part of the write-in field to the next memory cell 88. Since it is not the writing of the data of the intentional memory cell 88, the problem of dependability occurs by fluctuation of a switching field.
[0007]
[Problem(s) to be Solved by the Invention] The object of this invention has a small current for writing, and fluctuation of the switching field of a memory cell is offering a small storage element, a memory cell, and a store circuit block.
[0008]
[Means for Solving the Problem] Two or more layers pile up and are put together, and the summary of the storage element of this invention contains the centrum formed so that these two or more layers might be penetrated in a part for the core of the layer of the ferromagnetic from which the direction of magnetization

changes with the directions of a field into these two or more layers, and two or more of said layers.
[0009] The summary of other storage elements is a storage element containing the layer of the ferromagnetic from which two or more layers pile up and are put together, and the direction of magnetization changes with the directions of a field into these two or more layers, and the ferromagnetic from which the direction of said magnetization changes The 1st layer, It is including the 1st pillar-shaped object which connects one sides of the 2nd layer, and the this 1st layer and this 2nd layer, and the 2nd pillar-shaped object which connects the other sides of this 1st layer and the 2nd layer.
[0010] The summary of the memory cell of this invention is a memory cell containing the storage element containing the layer of the ferromagnetic from which the direction of magnetization changes with the directions of a field, the layer of the insulator which passes tunnel current, the layer of the ferromagnetic with which the direction of magnetization was fixed, and the layer of the antiferromagnetic substance for fixing the direction of magnetization of the layer of a ferromagnetic, and is that the amount of [of two or more layers contained in said storage element] core is a centrum. Moreover, the conductor which passes one write-in current which passes through the inside of a centrum is included.
[0011] The summary of other memory cells is that the conductor which passes two write-in currents which pass the centrum constituted with the 1st layer which constitutes the layer of the ferromagnetic from which other above-mentioned storage elements and the direction of magnetization change, the 2nd layer, the 1st pillar-shaped object, and the 2nd pillar-shaped object is included. Moreover, this memory cell is having turned to the direction where the direction of the magnetization which touches the ferromagnetic of the antiferromagnetic substance of the 1st layer and the 2nd layer is the same.
[0012] The summary of a store circuit block of this invention is that the conductor which reads with the conductor which passes a write-in current, and passes a current has been arranged in the shape of a matrix, and has arranged the above-mentioned memory cell to the intersection.
[0013] Said 1st layer from which the summary of other store circuit blocks constitutes the layer of the ferromagnetic from which other above-mentioned storage elements and the direction of said magnetization change, The conductor which passes two write-in currents which pass the hollow circles constituted with the 2nd layer, the 1st pillar-shaped object, and the 2nd pillar-shaped object by non-contact, It is the store circuit block which has a memory cell containing the conductor which was connected to the layer of the 1st antiferromagnetic substance, and the layer of the 2nd antiferromagnetic substance, and which reads and passes a current, and is in the conductor which passes said two write-in currents having arranged in the shape of a matrix, and having arranged said memory cell to the intersection.
[0014]
[Embodiment of the Invention] The gestalt of implementation of the storage element of this invention, a memory cell, and a store circuit block is explained using a drawing.
[0015] As shown in drawing 1 and drawing 2 , two or more layers pile up and are put together, two or more of the layers are penetrated to a part for the core, a centrum 19 is formed in it, and the storage element 10 has become frame-like (annular). Two or more layers contain the free ferromagnetism layer 12 which is a layer of the ferromagnetic from which the direction of magnetization changes with the directions of a field, the tunnel barrier 14 which is the layer of the insulator which passes tunnel current, the fixed magnetic layer 16 which is a layer of the ferromagnetic with which the direction of magnetization is being fixed, and the antiferromagnetism layer 18 which is a layer of the antiferromagnetic substance which fixes the direction of magnetization of a fixed magnetic layer. The direction of the arrow head in drawing is the direction of magnetization. The direction of magnetization is annular as a core, and has closed the centrum 19. Therefore, an anti-field does not occur in a storage element 10. In addition, the direction of magnetization of the antiferromagnetism layer 18 expresses the direction of the magnetization in an interface with the layer (fixed magnetic layer 16) of an adjoining ferromagnetic. Moreover, since a storage element 10 is used into a logic chip etc., the matter equivalent to air, for example, an insulator, may be filled by the inside of a centrum 19.
[0016] The values of the data currently written in by the direction of the magnetization of the free ferromagnetism layer 12 to the direction of magnetization of the fixed magnetic layer 16 differ. For example, if the direction of magnetization is the same, it will be data of "0", and it will be data of "1" if the directions of magnetization differ. Distinction of data is distinguished with the resistance of a storage element 10. When the data of "0" are compared with the data of "1", the direction of the data of "1" is high resistance.

[0017] The conductor 22 which writes in the centrum 19 prepared in a part for the core of a storage element 10, and passes Current Iw passes along the memory cell 20. The conductor 22 and storage element 10 which pass a write-in current are non-contact.
[0018] A field arises by writing in the conductor 22 which passes the write-in current Iw, and passing a current. The direction of a field follows Ampere's law (principle of a right-handed screw). Therefore, in drawing 1 , when it writes in caudad from the upper part of the conductor 22 which passes the write-in current Iw and Current Iw flows, the direction of magnetization of the free ferromagnetism layer 12 serves as sense of the direction of an arrow head of drawing. Moreover, when it writes in the upper part from the lower part of a conductor 22 which passes a write-in current and Current Iw flows, the direction of magnetization of the free ferromagnetism layer 12 turns into the direction of an arrow head of drawing in an opposite direction.
[0019] In drawing 1 , when writing the data of "0" in a memory cell 20, it writes in the upper part from the lower part of a conductor 22 which passes a write-in current, and Current Iw is passed. When writing in the data of "1" reversely, it writes in caudad from the upper part of the conductor 22 which passes a write-in current, and Current Iw is passed.
[0020] The conductor 24 which reads to the free ferromagnetism layer 12 and passes a current is connected. Moreover, the conductor 26 which reads also to the fixed magnetic layer 16 and the antiferromagnetism layer 18, and passes a current is connected. The data memorized by the storage element 10 can be read by reading to the conductors 24 and 26 which pass this read-out current, and passing Current Ir.
[0021] Distinction of data uses that the electrical potential difference between storage elements 10 changes with resistance of a storage element 10. As mentioned above, in the case of the data of "0", it is low resistance and an electrical potential difference becomes low. Moreover, in the case of the data of "1", it is high resistance and an electrical potential difference becomes high.
[0022] Magnetization of each class of a storage element 10 forms the closed magnetic circuit, i.e., a closed magnetic circuit, when each class has a frame-like form. In this closed magnetic circuit, the anti-field which magnetic field strength can weaken along with a storage element 10 is not generated, but the magnetic potential of a memory cell 20 is dramatically stabilized by this.
[0023] The current Iw of writing flows through the conductor 22 which passes a main write-in current, and has the direction of magnetization of the free ferromagnetism layer 12 switched with a small current. The switching field of this memory cell 20 is not a deciding [it is decided by the amount of sum total currents which mainly flows inside a closed circuit, and]-by configuration of frame thing. Therefore, the direction change of magnetization of a memory cell 20 is strictly controllable. Often controlling a SUITCHINGU field and when the magnetic potential of a memory cell 20 is dramatically stable, the dependability of a memory cell 20 improves.
[0024] The store circuit block using the memory cell 20 of drawing 1 is explained. The conductors 24 and 26 with which it reads with the conductor 22 with which a write-in current flows, and a current flows are constituted in the shape of a matrix, and a memory cell 20 is arranged to the intersection. the conductor with which in other words the write-in current of the adjacent memory cell 20 flows -- they are the conductor 24 with which reading appearance is carried out to 22 comrades, and a current flows, and the configuration where 26 comrades were connected. This store circuit block is applicable to the chip containing MRAM (Magnetic Random Access Memory) or MRAM. Moreover, it is also possible to arrange two or more memory cells 20 to one dimension, and to use it for the store circuit block of the one-dimensional array of Logic LSI, for example, a 8-bit register etc., without constituting a store circuit block in the shape of a matrix.
[0025] Other storage elements 30 are explained. As shown in drawing 3 (a), the free ferromagnetism layer which is a layer of the ferromagnetic from which the direction of magnetization changes with the directions of a field the [which connects one side of one side of A1 A2, the other sides B1 that counter, and B-2s with the A1 and 1st pillar-shaped object 36 with which the 1st layer 32, the 1st layer 32 and the 2nd parallel and non-contact layer 34, and the 1st layer 32 and the 2nd layer 34 counter, and which connect A2 comrades] -- it comes out with 2 pillar-shaped objects 38, and is constituted. The 1st layer 32 and 2nd layer 34 have fixed spacing. As mentioned above, with the 1st layer 32, the 2nd layer 34, the 1st pillar-shaped object 36, and the 2nd pillar-shaped object 38, a free ferromagnetism layer forms an annular solid 31, and forms the centrum 39 in a part for the core. Moreover, the magnetic circuit closed by the free ferromagnetism layer, i.e., a closed magnetic circuit, is formed in the surroundings of this centrum 39. In addition, since a storage element 30 is used into a logic chip

etc., the matter equivalent to air, for example, an insulator, may be filled by the inside of a centrum 39.
[0026] The 1st antiferromagnetism layer 44 which is the layer of the antiferromagnetic substance which determines the direction of magnetization of the 1st tunnel barrier 40 which is the insulating layer which passes tunnel current, the 1st fixed magnetic layer 42 which is the layer of the ferromagnetic with which the direction of magnetization was fixed, and the 1st fixed magnetic layer 42 on the 1st layer 32 (the 2nd layer 34 on the field of an opposite direction), and is fixed piles up and is put together in this sequence.
[0027] The 2nd antiferromagnetism layer 56 which is the layer of the antiferromagnetic substance which determines the direction of magnetization of the 2nd tunnel barrier 46 which is the insulating layer which passes tunnel current, the 2nd fixed magnetic layer 54 which is the layer of the ferromagnetic with which the direction of magnetization was fixed, and the 2nd fixed magnetic layer 54 on the 2nd layer 34 (the 1st layer 32 on the field of an opposite direction), and is fixed piles up and is put together in this sequence.
[0028] In the 2nd fixed magnetic layer 54, the 2nd antiferromagnetism layer 56 is constituted by the layer 48 in which the direction of magnetization by the 2nd antiferromagnetism layer 56 has the direction of magnetization of an opposite direction by the layer 52 currently determined and fixed, the layer 50 which reverses the direction of magnetization, and the layer which reverses the direction of magnetization. As for the layer 50 which reverses the direction of magnetization, it is desirable to consist of rutheniums.
[0029] The arrow head shown in each class of drawing 3 (a) shows the direction of magnetization. The direction of magnetization of a free ferromagnetism layer is annular, and is closed. The MTJ component is formed in the 1st layer 32, the 1st tunnel barrier 40, the 1st fixed MAG layer 42, and the 1st antiferromagnetism layer 44. Moreover, the MTJ component is formed also in the 2nd layer 34, the 2nd tunnel barrier 46, the 2nd fixed MAG layer 54, and the 2nd antiferromagnetism layer 56. That is, two MTJ components are formed.
[0030] The inside which constitutes the direction of the magnetization of the 1st layer 32 to the direction of magnetization of the 1st fixed MAG layer 42 and the 2nd fixed MAG layer 54 comes out further, and the direction of the magnetization of the 2nd layer 34 to the direction of magnetization of a certain layer 48 determines the data memorized. For example, if the direction of magnetization is an opposite direction as shown in drawing, it is data of "1", and it is data of "0" if the direction of magnetization is the same direction.
[0031] Moreover, the 2nd fixed magnetic layer 54 explains the reason containing the layer 48 which has the direction of magnetization of an opposite direction in the 2nd antiferromagnetism layer 56. The 1st antiferromagnetism layer 44 and the 2nd antiferromagnetism layer 56 need to make the direction of magnetization the same. The direction of magnetization of the antiferromagnetic substance is determined by heat treatment after film formation among a field (heat treatment performed while carrying out the seal of approval of the field), and this is because magnetization of the antiferromagnetic substance of the 1st antiferromagnetism layer 44 and the 2nd antiferromagnetism layer 56 turns to the same direction by heat treatment among a field. The direction of magnetization of the antiferromagnetic substance of the 1st antiferromagnetism layer 44 and the 2nd antiferromagnetism layer 56 is made the same. And the layers 32, 34, 36, and 38 of the ferromagnetic from which the direction of magnetization changes with the directions of a field form a closed magnetic circuit. Furthermore, in order to make the same relation of the magnetization of the layer of a ferromagnetic which faces on both sides of the tunnel barriers 40 and 46 in the 1st layer 32 and 2nd layer 34, it is necessary to reverse magnetization of the 2nd fixed magnetic layer 54 once.
[0032] The memory cell 58 which used the storage element 30 is explained. Two conductors 62 and 64 have passed to the centrum 39 formed in a part for the core of a free ferromagnetism layer. These two conductors are the conductors 62 and 64 for passing the write-in currents Iwy and Iwx.
[0033] In drawing 3 (a), when writing the data of "1" in a storage element 30, the conductors 62 and 64 for passing two write-in currents are written in in the direction of the back from this side, and Currents Iwy and Iwx flow. Moreover, when writing in the data of "0", the conductors 62 and 64 for passing two write-in currents are written in this side from the back, and Currents Iwy and Iwx flow.
[0034] The conductor 60 with which it reads to the 1st antiferromagnetism layer 44 and the 2nd antiferromagnetism layer 56, and a current flows is connected. The data of a storage element 30 can be read by passing the read-out current Ir. Distinction of data is distinguished with the resistance of a storage element 30. In the case of the data of "0", it is low resistance and an electrical potential difference becomes low. In the case of the data of "1", it is high resistance and an electrical potential difference becomes high.
[0035] Since the write-in currents Iwy and Iwx flow the interior of a closed magnetic circuit, a current is used

effectively to switch magnetization and a current required for a change is very low current as compared with the conventional memory cell 80. Moreover, the circuit closed magnetically is dramatically stable to an external magnetic field, and, for this reason, fixed and stabilized the change of the direction of magnetization of a memory cell 58 and improvement in the dependability of memory operation can be realized.
[0036] The store circuit block 70 using a memory cell 58 is explained. As shown in drawing 3 (b), the conductors 62 and 64 which pass two write-in currents are constituted in the shape of a matrix, and a memory cell 30 is arranged to the intersection. In other words, they are the conductor 62 which passes two write-in currents of the adjacent memory cell 58, and the configuration where 64 comrades were connected. Switching elements 66a and 66b are formed in the edge of two conductors 62 and 64, and ON and OFF of a write-in current are performed. Switching elements 66a and 66b use MOSFET.
[0037] Moreover, the write-in current actuation circuits 68a and 68b for writing in switching elements 66a and 66b, and passing a current are formed.
[0038] Store circuit block 70 like drawing 3 (b) is applicable to the chip containing MRAM or MRAM.
[0039] In drawing 3 , a lengthwise direction is made into the direction of the column address, and a longitudinal direction is made into the direction of a row address. For example, when writing data in the upper left memory cell 30 in drawing 3 R> 3, switching elements 66a and 66b are turned ON, it writes in the left-hand side conductor 62 and the upper conductor 64, and a current is passed.
[0040] Moreover, it is also possible to arrange two or more memory cells 58 to one dimension, and to use it for the store circuit block of the one-dimensional array of Logic LSI, for example, a 8-bit register etc., without constituting the store circuit block 70 in the shape of a matrix.
[0041] As mentioned above, since the conductor with which a write-in current flows passes along a part for the core of a free ferromagnetism layer, all the fields generated around the conductor with which a write-in current flows can use it for changing the direction of magnetization. Therefore, a write-in current can be reduced. Moreover, since the direction of magnetization became annular in the free ferromagnetism layer and the field has closed, it is possible to weaken magnetic field strength generated around the conductor with which an anti-field does not occur and a write-in current flows. It can write in also by this and a current can be reduced.
[0042] As mentioned above, although the storage element of this invention, the memory cell, and the store circuit block were explained, this invention is not limited to these. This invention can be carried out in the mode which added the amelioration which becomes various based on this contractor's information in the range which does not deviate from the meaning, correction, and deformation.
[0043]
[Effect of the Invention] By this invention, the writing of data was attained by low current as compared with the conventional memory cell. Moreover, since it passes along the inside of the magnetic circuit which the write-in current closed, localization is carried out to the memory cell in which the field by the write-in current is written, and other memory cells are not affected.

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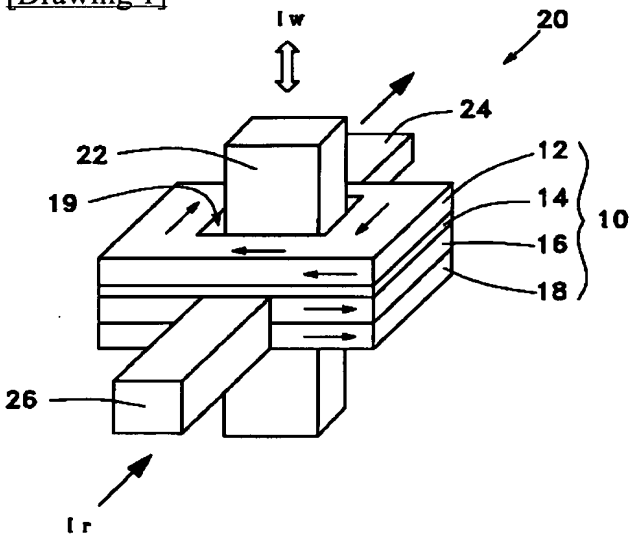
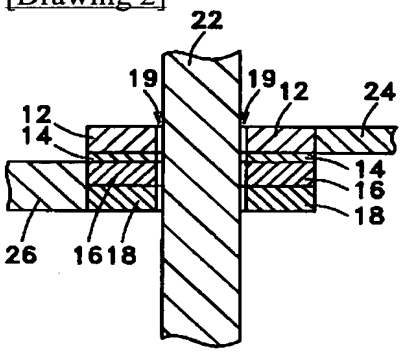
DRAWINGS

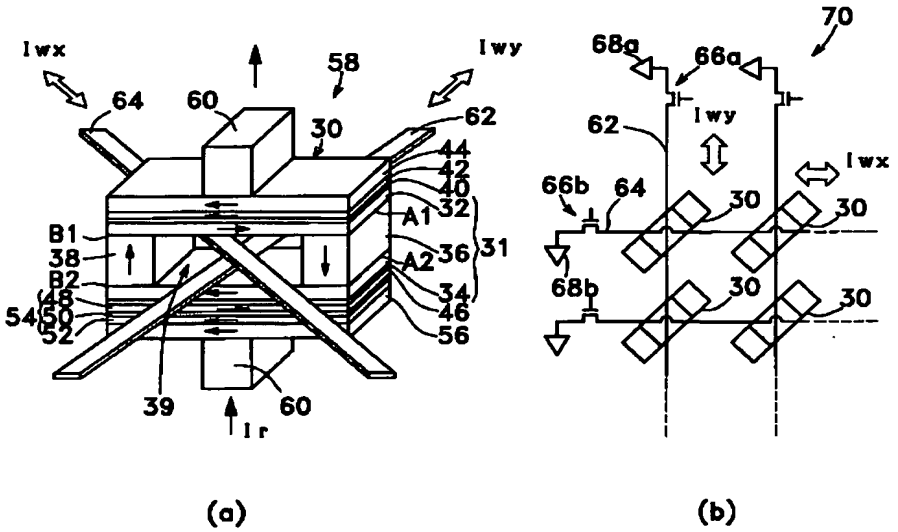
[Drawing 1]



[Drawing 2]

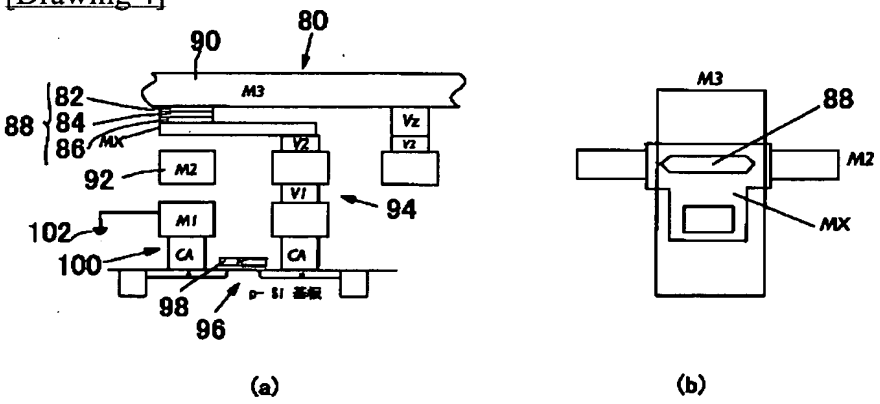


[Drawing 3]



(a) (b)

[Drawing 4]



(a) (b)

[Translation done.]